FIG. 1

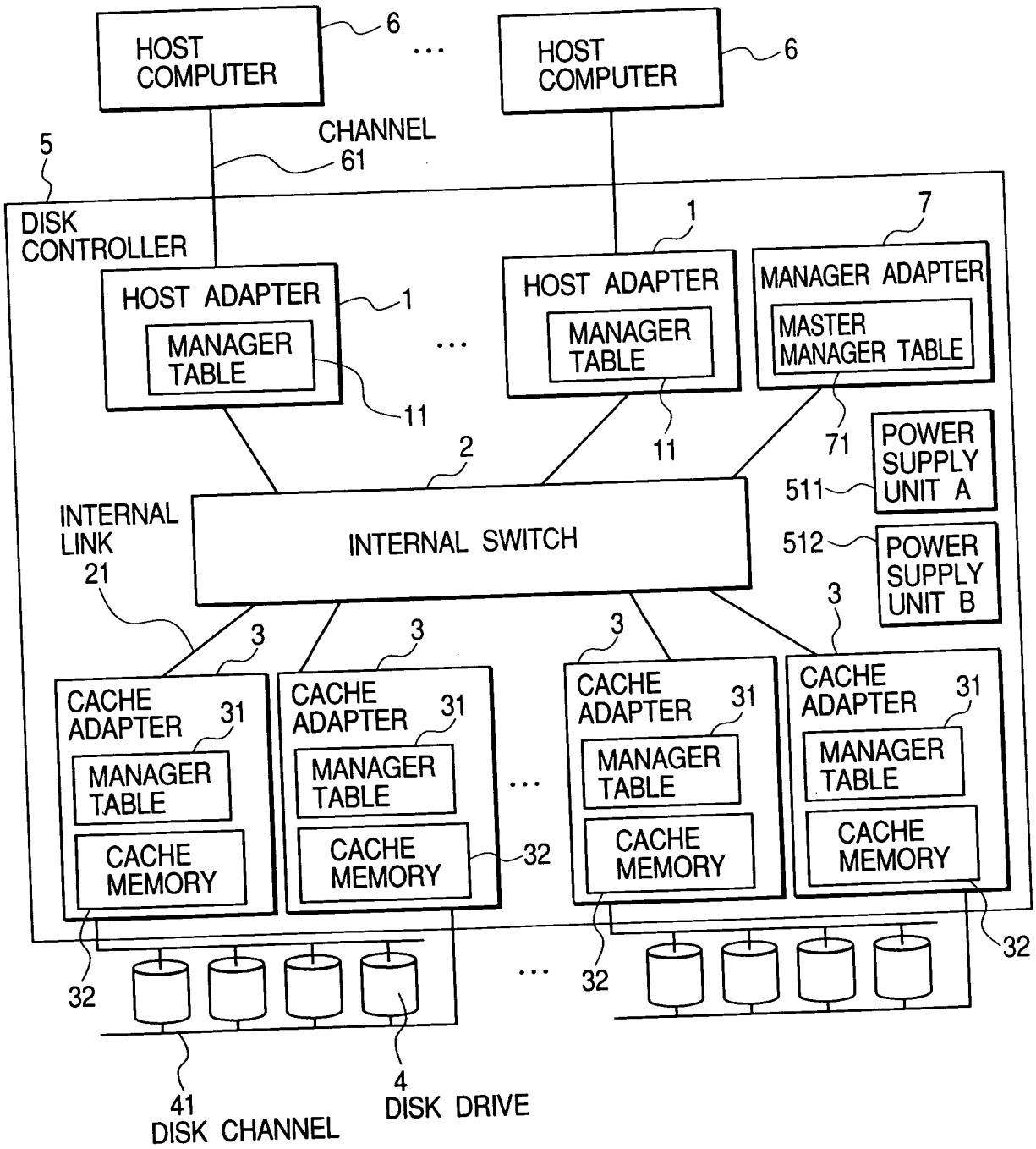

HOST COMPUTER
6
HOST COMPUTER
6
CHANNEL
61
5
DISK CONTROLLER
HOST ADAPTER
1
MANAGER TABLE
11
HOST ADAPTER
1
MANAGER TABLE
11
MANAGER ADAPTER
7
MASTER MANAGER TABLE
71
2
INTERNAL LINK
21
INTERNAL SWITCH
POWER SUPPLY UNIT A
511
POWER SUPPLY UNIT B
512
3
CACHE ADAPTER
31
MANAGER TABLE
CACHE MEMORY
32
41
DISK CHANNEL
4
DISK DRIVE

FIG. 2

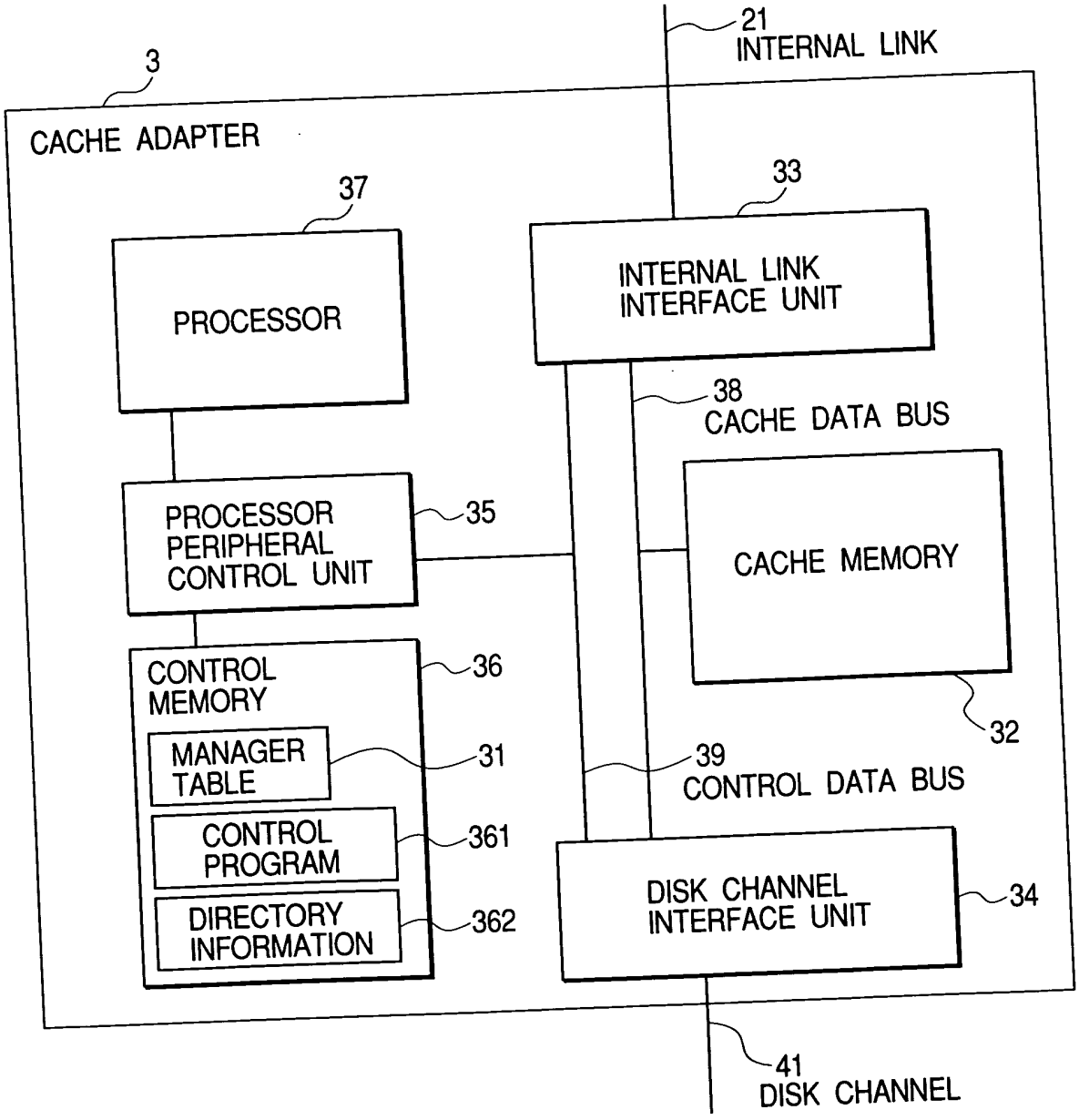

21
INTERNAL LINK
3
CACHE ADAPTER
37
PROCESSOR
33
INTERNAL LINK
INTERFACE UNIT
38
CACHE DATA BUS
PROCESSOR
PERIPHERAL
CONTROL UNIT
35
CACHE MEMORY
CONTROL
MEMORY
36
MANAGER
TABLE
31
32
39
CONTROL DATA BUS
CONTROL
PROGRAM
361
DISK CHANNEL
INTERFACE UNIT
34
DIRECTORY
INFORMATION
362
41
DISK CHANNEL

FIG. 3

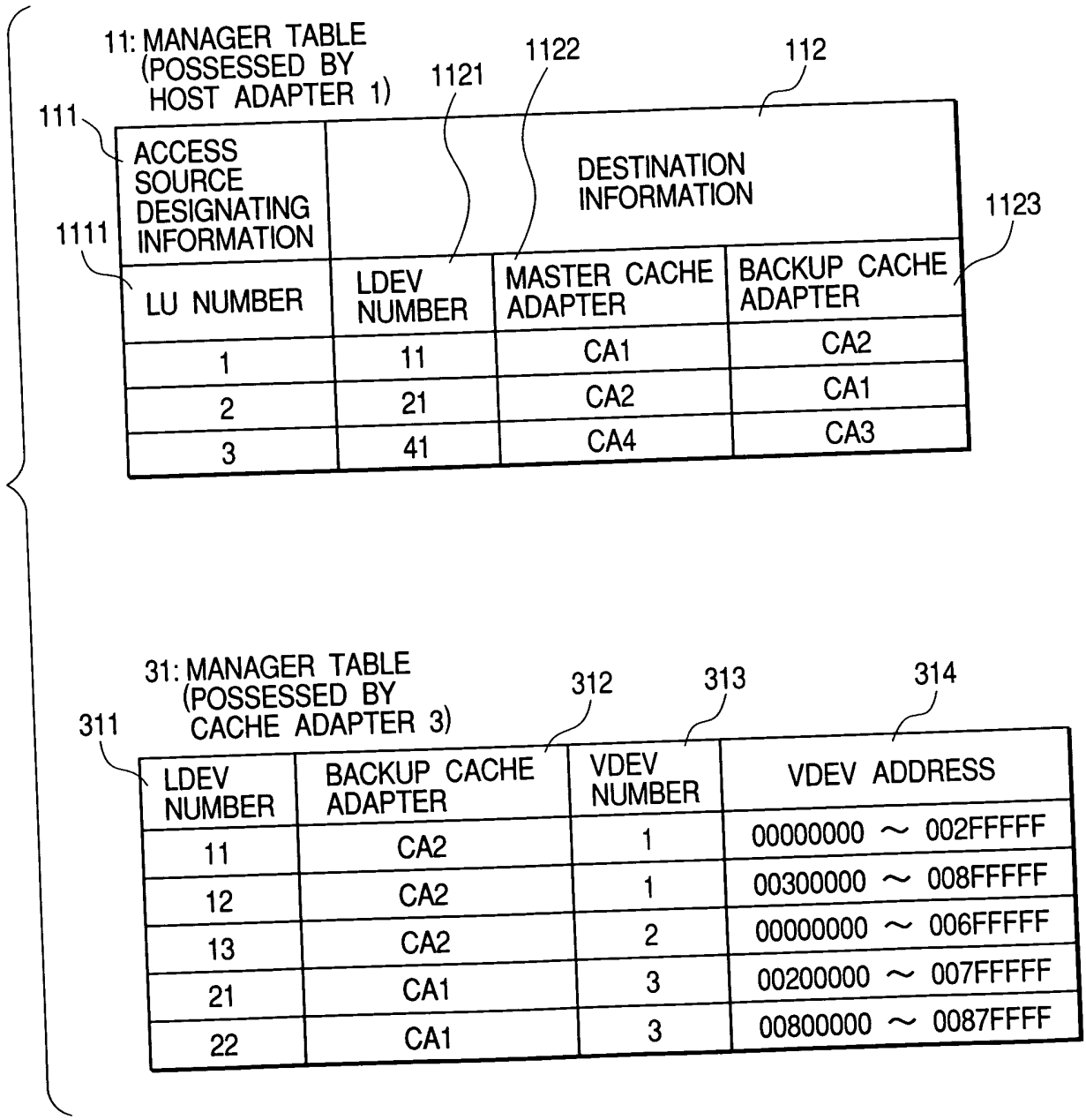

11: MANAGER TABLE (POSSESSED BY HOST ADAPTER 1)
111
1111
1121
1122
112
1123
ACCESS SOURCE DESIGNATING INFORMATION
DESTINATION INFORMATION
LU NUMBER
LDEV NUMBER
MASTER CACHE ADAPTER
BACKUP CACHE ADAPTER
1 | 11 | CA1 | CA2
2 | 21 | CA2 | CA1
3 | 41 | CA4 | CA3
31: MANAGER TABLE (POSSESSED BY CACHE ADAPTER 3)
311
312
313
314
LDEV NUMBER
BACKUP CACHE ADAPTER
VDEV NUMBER
VDEV ADDRESS
11 | CA2 | 1 | 00000000 ~ 002FFFFF
12 | CA2 | 1 | 00300000 ~ 008FFFFF
13 | CA2 | 2 | 00000000 ~ 006FFFFF
21 | CA1 | 3 | 00200000 ~ 007FFFFF
22 | CA1 | 3 | 00800000 ~ 0087FFFF

FIG. 4

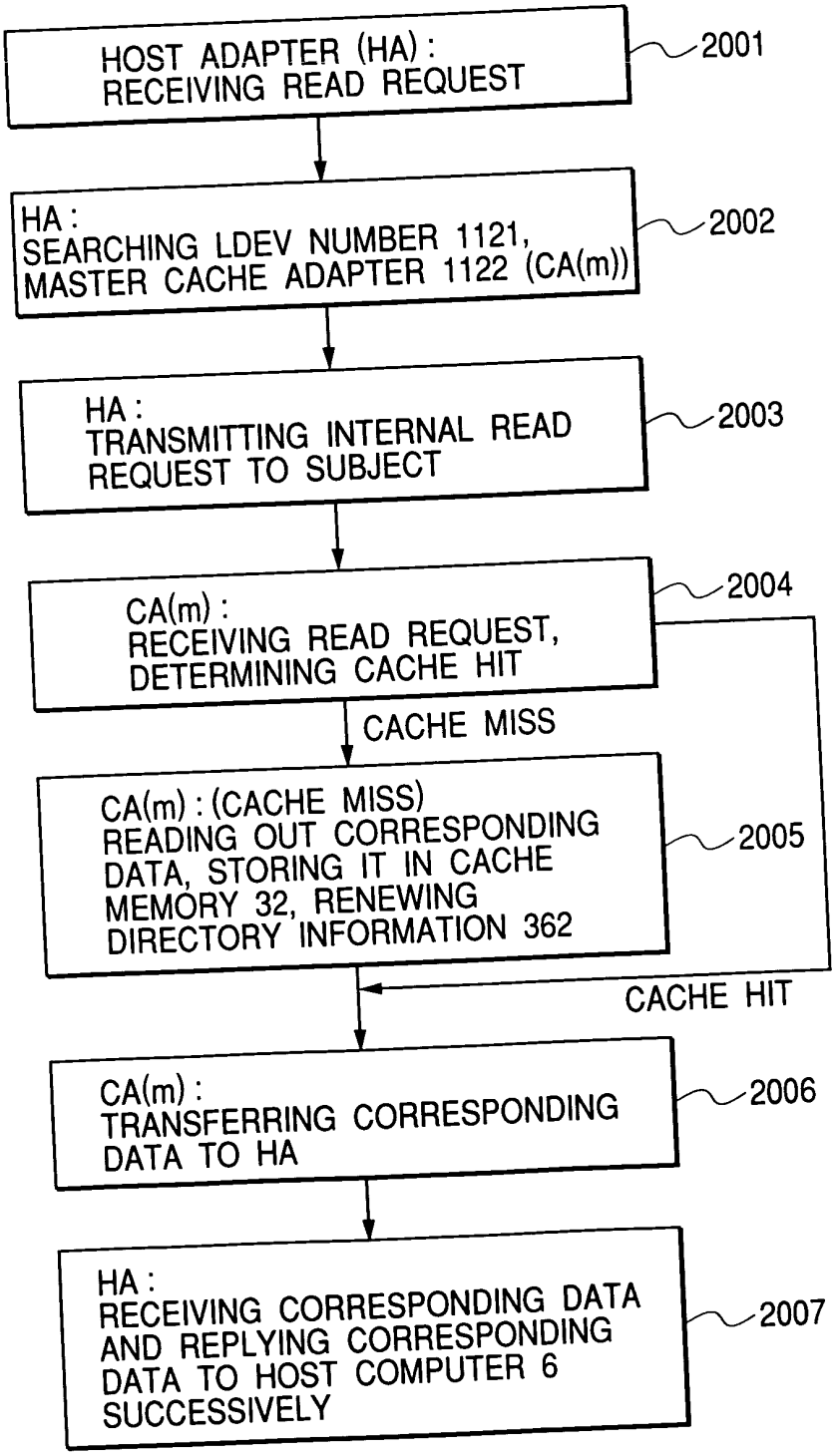

HOST ADAPTER (HA):
RECEIVING READ REQUEST
2001
HA:
SEARCHING LDEV NUMBER 1121,
MASTER CACHE ADAPTER 1122 (CA(m))
2002
HA:
TRANSMITTING INTERNAL READ
REQUEST TO SUBJECT
2003
CA(m):
RECEIVING READ REQUEST,
DETERMINING CACHE HIT
2004
CACHE MISS
CA(m): (CACHE MISS)
READING OUT CORRESPONDING
DATA, STORING IT IN CACHE
MEMORY 32, RENEWING
DIRECTORY INFORMATION 362
2005
CACHE HIT
CA(m):
TRANSFERRING CORRESPONDING
DATA TO HA
2006
HA:
RECEIVING CORRESPONDING DATA
AND REPLYING CORRESPONDING
DATA TO HOST COMPUTER 6
SUCCESSIVELY
2007

FIG. 5

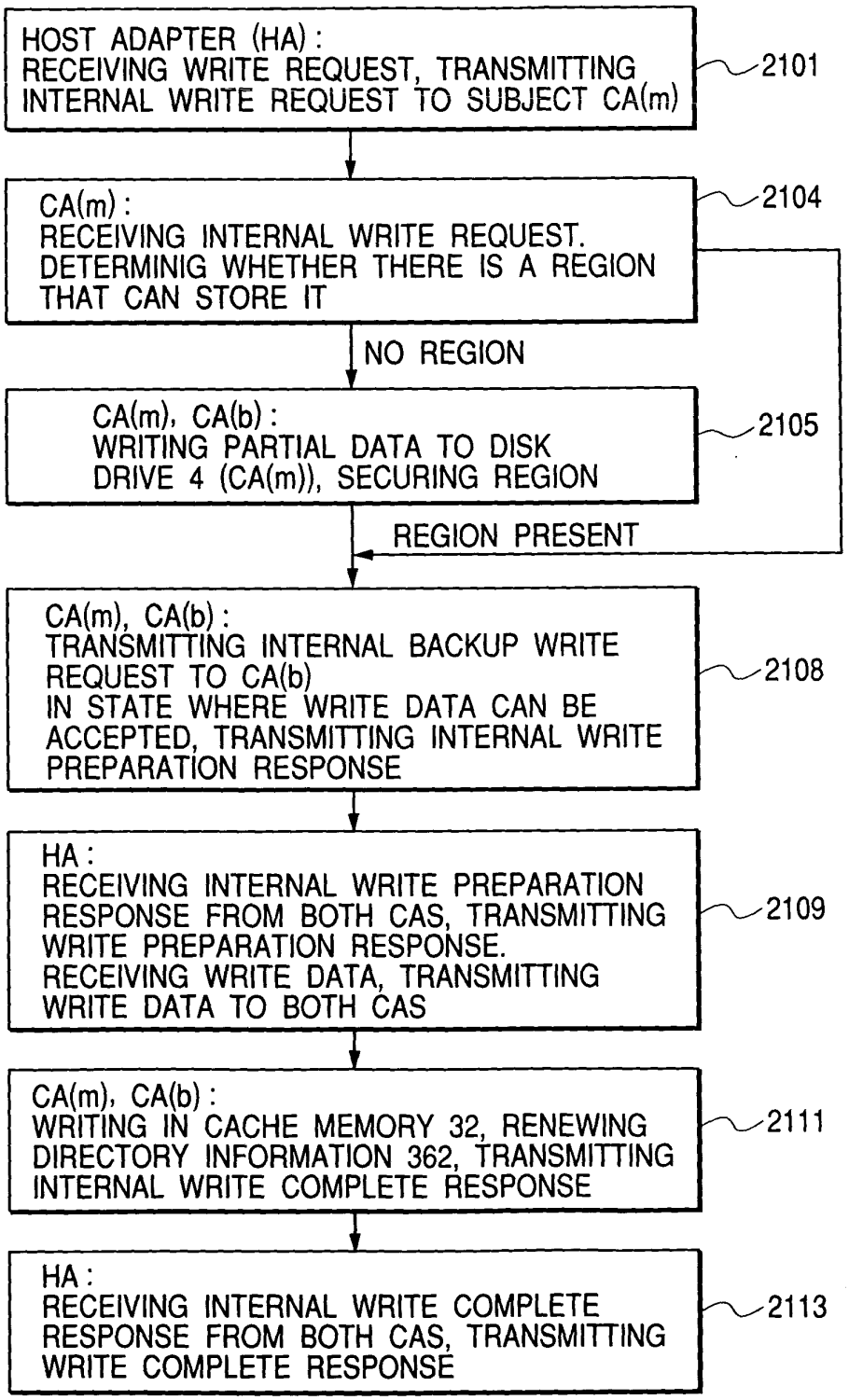

HOST ADAPTER (HA):
RECEIVING WRITE REQUEST, TRANSMITTING INTERNAL WRITE REQUEST TO SUBJECT CA(m)
2101
CA(m):
RECEIVING INTERNAL WRITE REQUEST.
DETERMINIG WHETHER THERE IS A REGION THAT CAN STORE IT
2104
NO REGION
CA(m), CA(b):
WRITING PARTIAL DATA TO DISK DRIVE 4 (CA(m)), SECURING REGION
2105
REGION PRESENT
CA(m), CA(b):
TRANSMITTING INTERNAL BACKUP WRITE REQUEST TO CA(b)
IN STATE WHERE WRITE DATA CAN BE ACCEPTED, TRANSMITTING INTERNAL WRITE PREPARATION RESPONSE
2108
HA:
RECEIVING INTERNAL WRITE PREPARATION RESPONSE FROM BOTH CAS, TRANSMITTING WRITE PREPARATION RESPONSE.
RECEIVING WRITE DATA, TRANSMITTING WRITE DATA TO BOTH CAS
2109
CA(m), CA(b):
WRITING IN CACHE MEMORY 32, RENEWING DIRECTORY INFORMATION 362, TRANSMITTING INTERNAL WRITE COMPLETE RESPONSE
2111
HA:
RECEIVING INTERNAL WRITE COMPLETE RESPONSE FROM BOTH CAS, TRANSMITTING WRITE COMPLETE RESPONSE
2113

FIG. 6

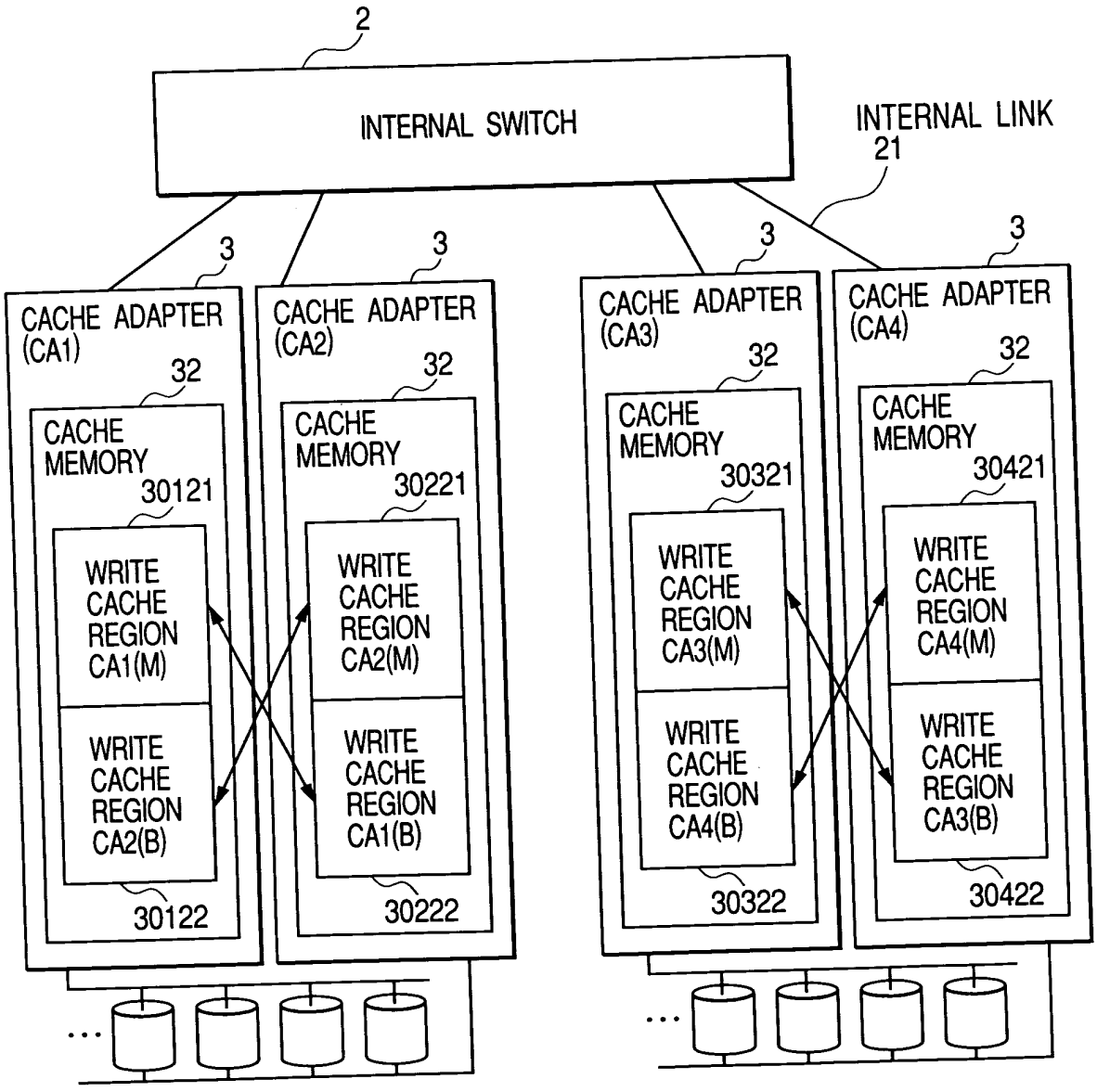

2
INTERNAL SWITCH
INTERNAL LINK
21
3
3
3
3
CACHE ADAPTER
(CA1)
CACHE ADAPTER
(CA2)
CACHE ADAPTER
(CA3)
CACHE ADAPTER
(CA4)
32
32
32
32
CACHE
MEMORY
30121
CACHE
MEMORY
30221
CACHE
MEMORY
30321
CACHE
MEMORY
30421
WRITE
CACHE
REGION
CA1(M)
WRITE
CACHE
REGION
CA2(B)
30122
WRITE
CACHE
REGION
CA2(M)
WRITE
CACHE
REGION
CA1(B)
30222
WRITE
CACHE
REGION
CA3(M)
WRITE
CACHE
REGION
CA4(B)
30322
WRITE
CACHE
REGION
CA4(M)
WRITE
CACHE
REGION
CA3(B)
30422

FIG. 7

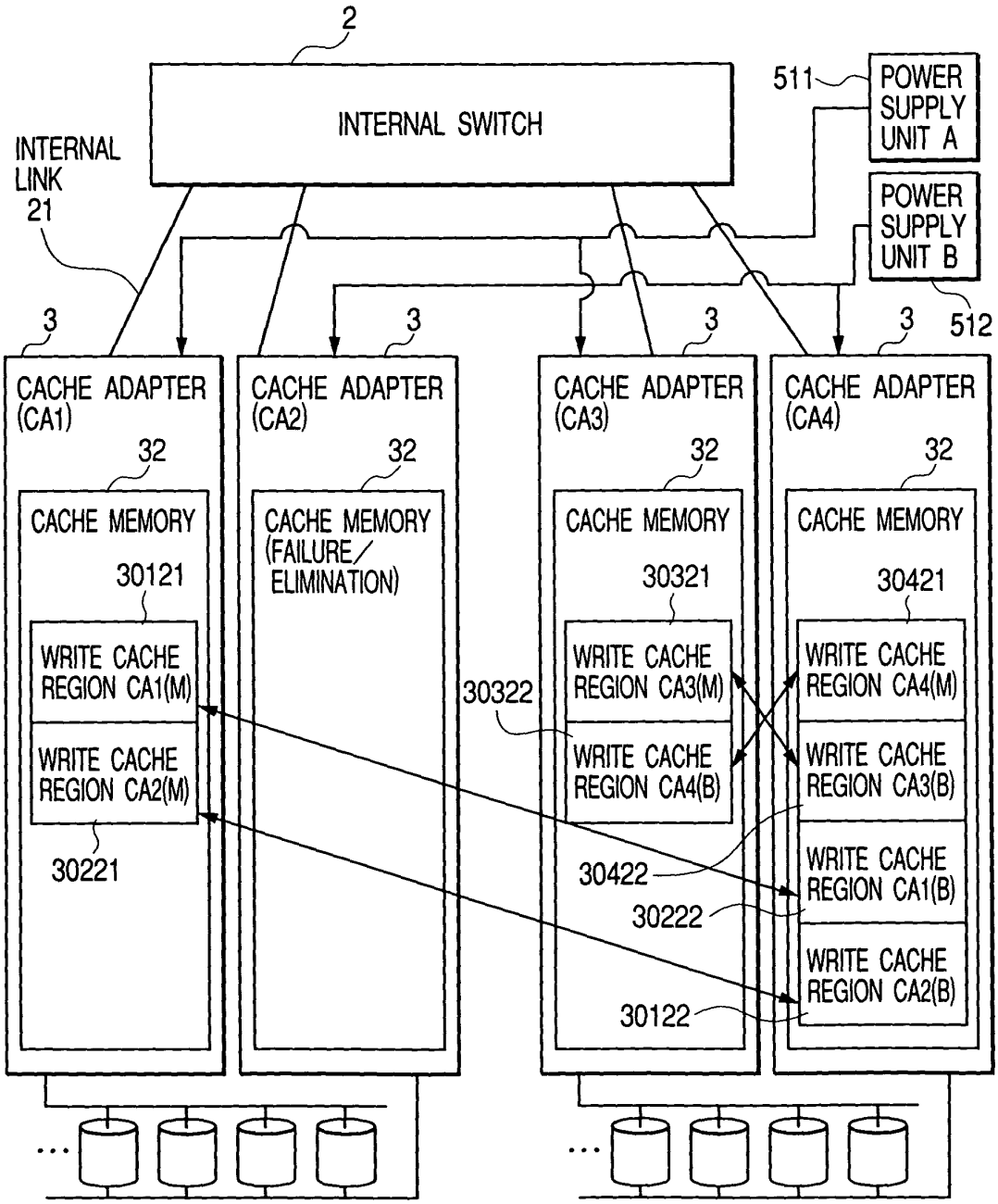

2
INTERNAL SWITCH
511
POWER SUPPLY UNIT A
POWER SUPPLY UNIT B
512
INTERNAL LINK 21
3
CACHE ADAPTER (CA1)
CACHE ADAPTER (CA2)
CACHE ADAPTER (CA3)
CACHE ADAPTER (CA4)
32
CACHE MEMORY
30121
WRITE CACHE REGION CA1(M)
WRITE CACHE REGION CA2(M)
30221
CACHE MEMORY (FAILURE ELIMINATION)
30321
WRITE CACHE REGION CA3(M)
30322
WRITE CACHE REGION CA4(B)
30422
30222
30122
30421
WRITE CACHE REGION CA4(M)
WRITE CACHE REGION CA3(B)
WRITE CACHE REGION CA1(B)
WRITE CACHE REGION CA2(B)

FIG. 8

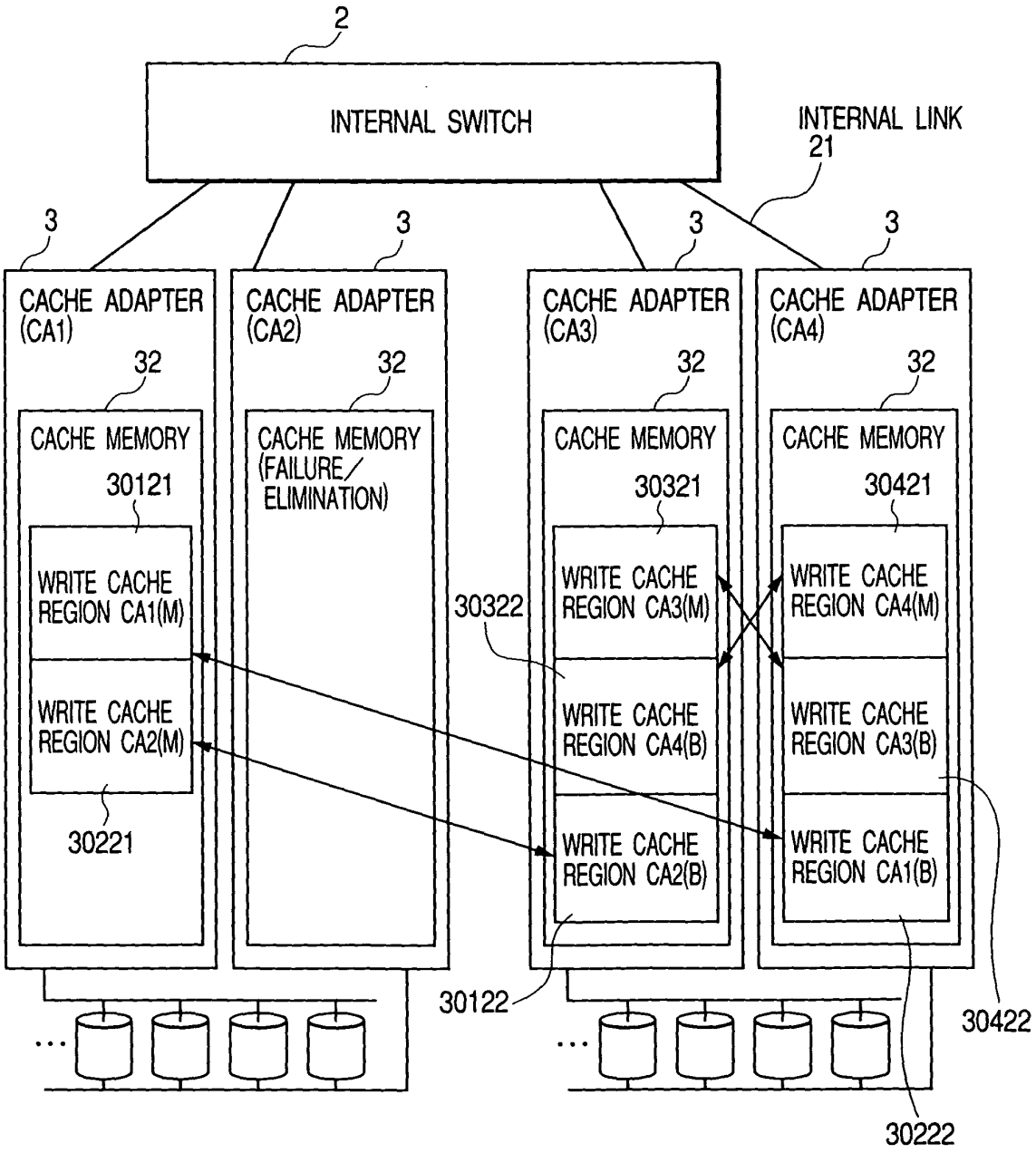

2
INTERNAL SWITCH
INTERNAL LINK
21
3
3
3
3
CACHE ADAPTER (CA1)
CACHE ADAPTER (CA2)
CACHE ADAPTER (CA3)
CACHE ADAPTER (CA4)
32
32
32
32
CACHE MEMORY
30121
CACHE MEMORY (FAILURE/ ELIMINATION)
CACHE MEMORY
30321
CACHE MEMORY
30421
WRITE CACHE REGION CA1(M)
WRITE CACHE REGION CA2(M)
30221
30322
WRITE CACHE REGION CA3(M)
WRITE CACHE REGION CA4(B)
WRITE CACHE REGION CA2(B)
WRITE CACHE REGION CA4(M)
WRITE CACHE REGION CA3(B)
WRITE CACHE REGION CA1(B)
30122
30422
30222

FIG. 9(A)

71 MASTER MANAGER TABLE
(POSSESSED BY MANAGER ADAPTER 7)

711: CACHE ADAPTER CORRESPONDING TABLE

7111 LDEV NUMBER	7112 MASTER CACHE ADAPTER	7113 BACKUP CACHE ADAPTER
11	CA1	CA2
12	CA1	CA2
21	CA2	CA1
22	CA2	CA1
31	CA3	CA4
41	CA4	CA3

712: CACHE ADAPTER PAIR TABLE

7121 CACHE ADAPTER PAIR	7122 FAILURE SUPPORT CACHE ADAPTER
(CA1, CA2)	(CA3, CA4)
(CA3, CA4)	(CA1, CA2)(CA3, CA4)
(CA5, CA6)	CA4

FIG. 9(B)

711

7111 LDEV NUMBER	7112 MASTER CACHE ADAPTER	7113 BUCKUP CACHE ADAPTER
11	CA1	CA4
12	CA1	CA4
21	CA1	CA3
22	CA1	CA3
31	CA3	CA4
41	CA4	CA3

FIG. 10

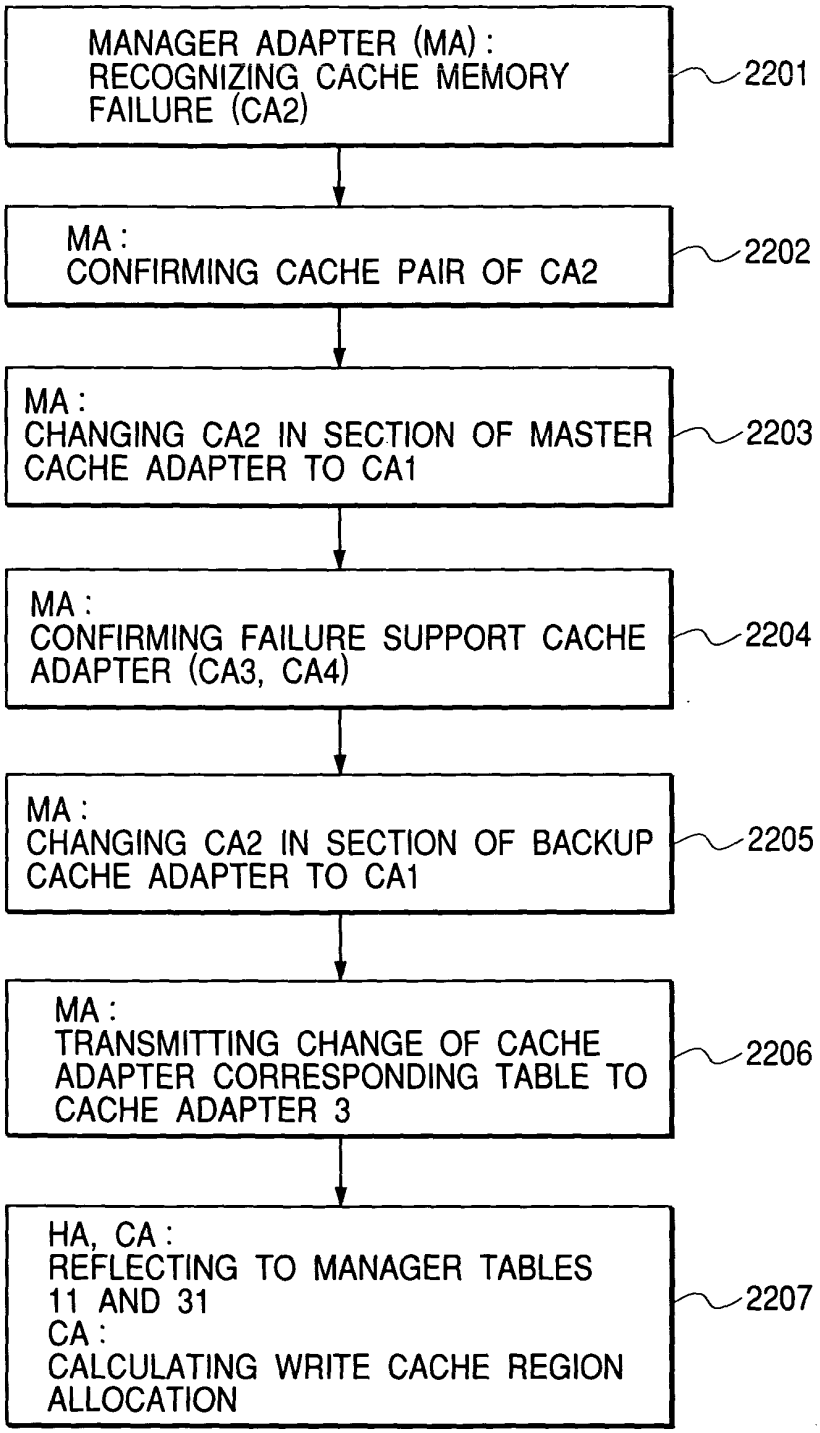

MANAGER ADAPTER (MA) : RECOGNIZING CACHE MEMORY FAILURE (CA2)
2201
MA : CONFIRMING CACHE PAIR OF CA2
2202
MA : CHANGING CA2 IN SECTION OF MASTER CACHE ADAPTER TO CA1
2203
MA : CONFIRMING FAILURE SUPPORT CACHE ADAPTER (CA3, CA4)
2204
MA : CHANGING CA2 IN SECTION OF BACKUP CACHE ADAPTER TO CA1
2205
MA : TRANSMITTING CHANGE OF CACHE ADAPTER CORRESPONDING TABLE TO CACHE ADAPTER 3
2206
HA, CA : REFLECTING TO MANAGER TABLES 11 AND 31
CA : CALCULATING WRITE CACHE REGION ALLOCATION
2207

FIG. 11

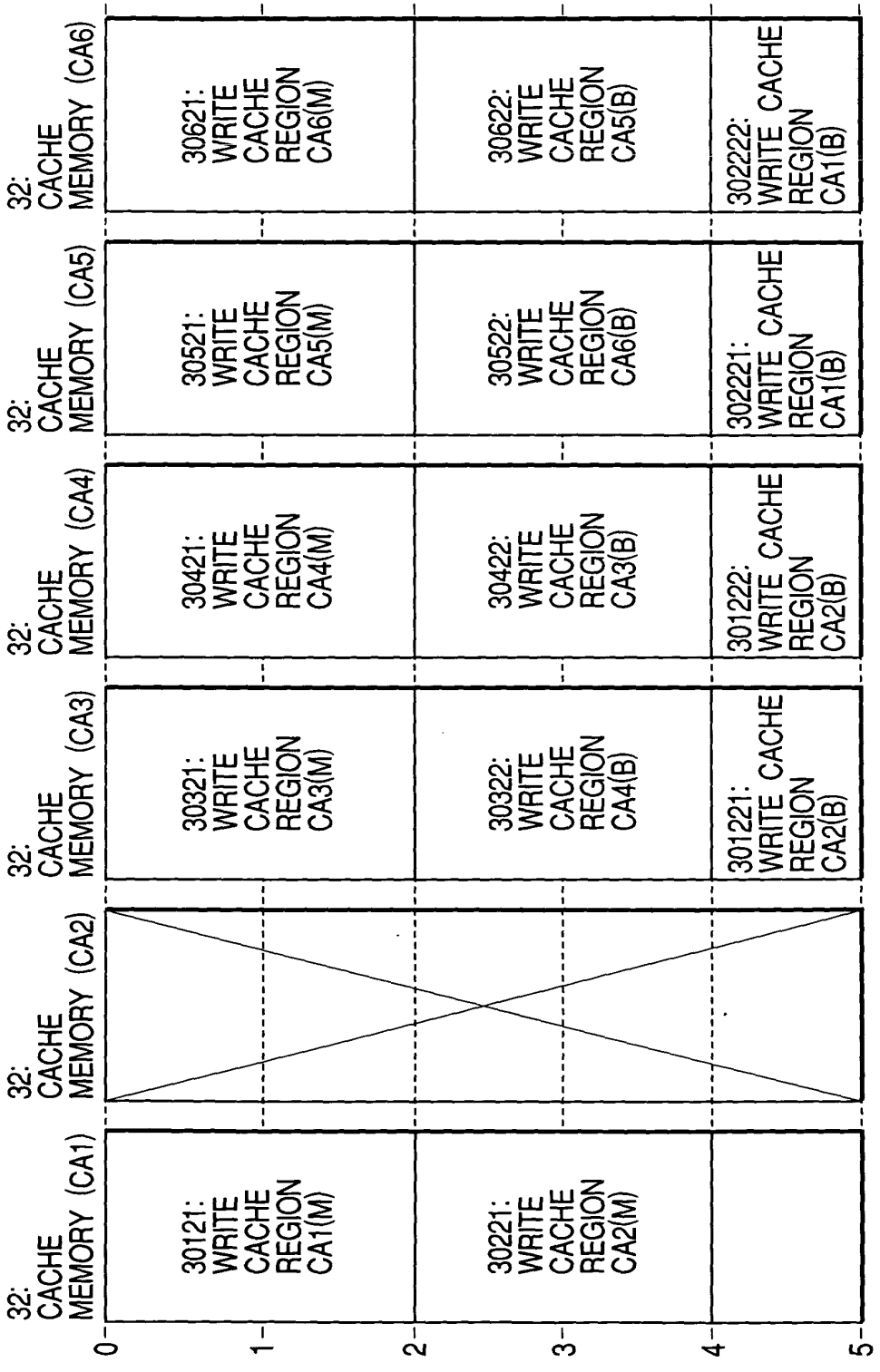

32: CACHE MEMORY (CA1)
32: CACHE MEMORY (CA2)
32: CACHE MEMORY (CA3)
32: CACHE MEMORY (CA4)
32: CACHE MEMORY (CA5)
32: CACHE MEMORY (CA6)
30121: WRITE CACHE REGION CA1(M)
30221: WRITE CACHE REGION CA2(M)
30321: WRITE CACHE REGION CA3(M)
30322: WRITE CACHE REGION CA4(B)
30421: WRITE CACHE REGION CA4(M)
30422: WRITE CACHE REGION CA3(B)
30521: WRITE CACHE REGION CA5(M)
30522: WRITE CACHE REGION CA6(B)
30621: WRITE CACHE REGION CA6(M)
30622: WRITE CACHE REGION CA5(B)
301221: WRITE CACHE REGION CA2(B)
301222: WRITE CACHE REGION CA2(B)
302221: WRITE CACHE REGION CA1(B)
302222: WRITE CACHE REGION CA1(B)
0
1
2
3
4
5

FIG. 12

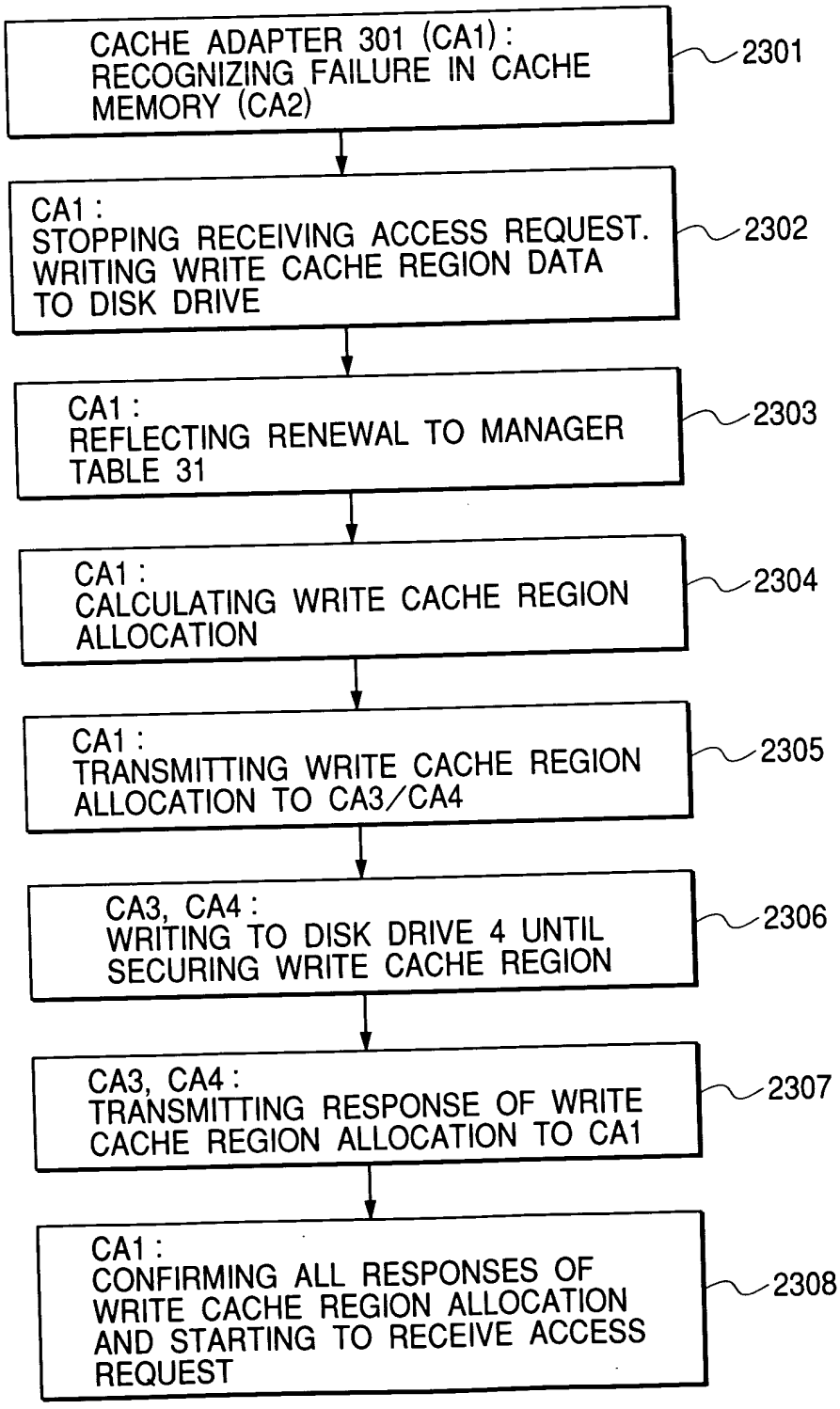

CACHE ADAPTER 301 (CA1): RECOGNIZING FAILURE IN CACHE MEMORY (CA2)
2301
CA1 : STOPPING RECEIVING ACCESS REQUEST. WRITING WRITE CACHE REGION DATA TO DISK DRIVE
2302
CA1 : REFLECTING RENEWAL TO MANAGER TABLE 31
2303
CA1 : CALCULATING WRITE CACHE REGION ALLOCATION
2304
CA1 : TRANSMITTING WRITE CACHE REGION ALLOCATION TO CA3/CA4
2305
CA3, CA4 : WRITING TO DISK DRIVE 4 UNTIL SECURING WRITE CACHE REGION
2306
CA3, CA4 : TRANSMITTING RESPONSE OF WRITE CACHE REGION ALLOCATION TO CA1
2307
CA1 : CONFIRMING ALL RESPONSES OF WRITE CACHE REGION ALLOCATION AND STARTING TO RECEIVE ACCESS REQUEST
2308

FIG. 13

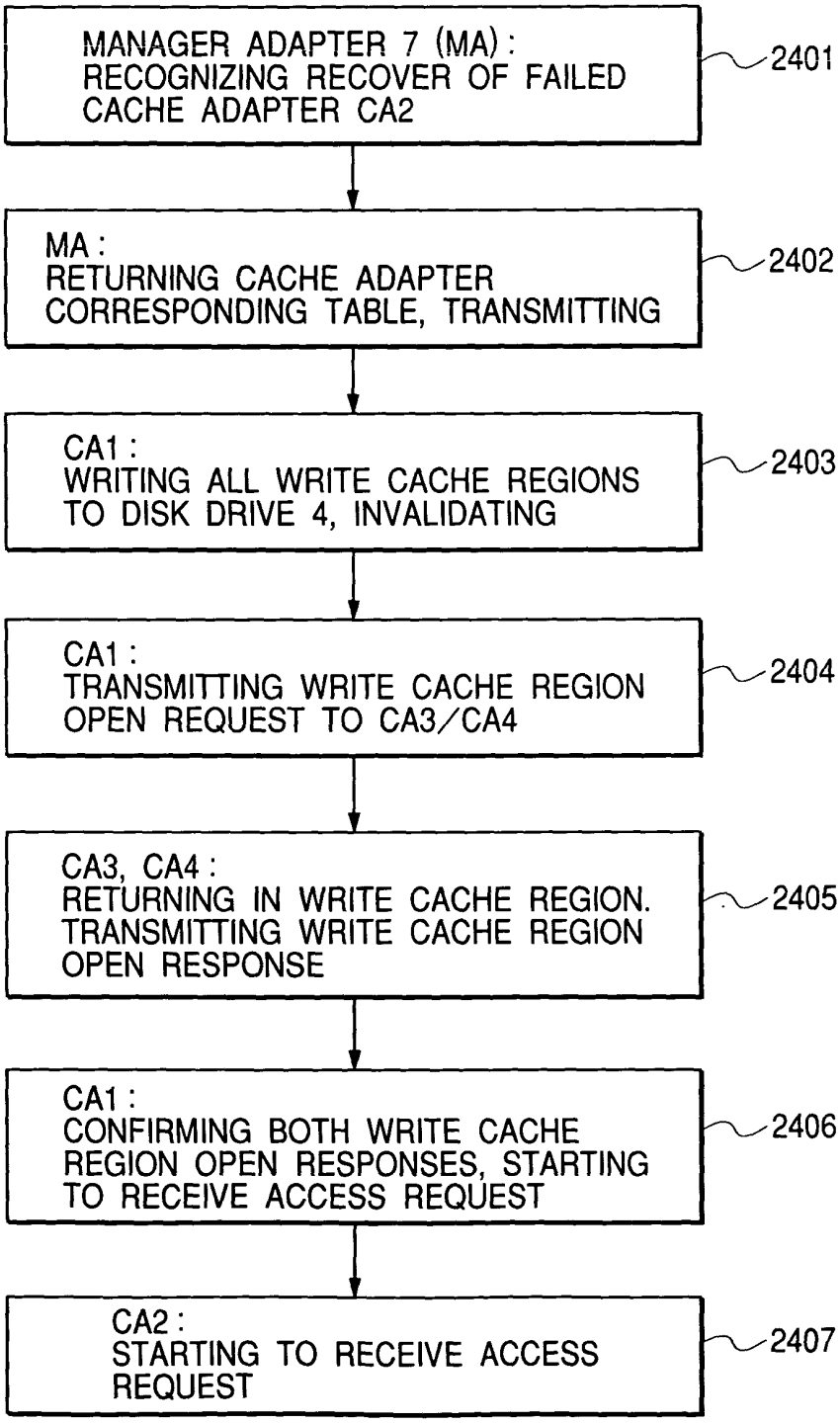

MANAGER ADAPTER 7 (MA) : RECOGNIZING RECOVER OF FAILED CACHE ADAPTER CA2
2401
MA : RETURNING CACHE ADAPTER CORRESPONDING TABLE, TRANSMITTING
2402
CA1 : WRITING ALL WRITE CACHE REGIONS TO DISK DRIVE 4, INVALIDATING
2403
CA1 : TRANSMITTING WRITE CACHE REGION OPEN REQUEST TO CA3/CA4
2404
CA3, CA4 : RETURNING IN WRITE CACHE REGION. TRANSMITTING WRITE CACHE REGION OPEN RESPONSE
2405
CA1 : CONFIRMING BOTH WRITE CACHE REGION OPEN RESPONSES, STARTING TO RECEIVE ACCESS REQUEST
2406
CA2 : STARTING TO RECEIVE ACCESS REQUEST
2407

FIG. 14

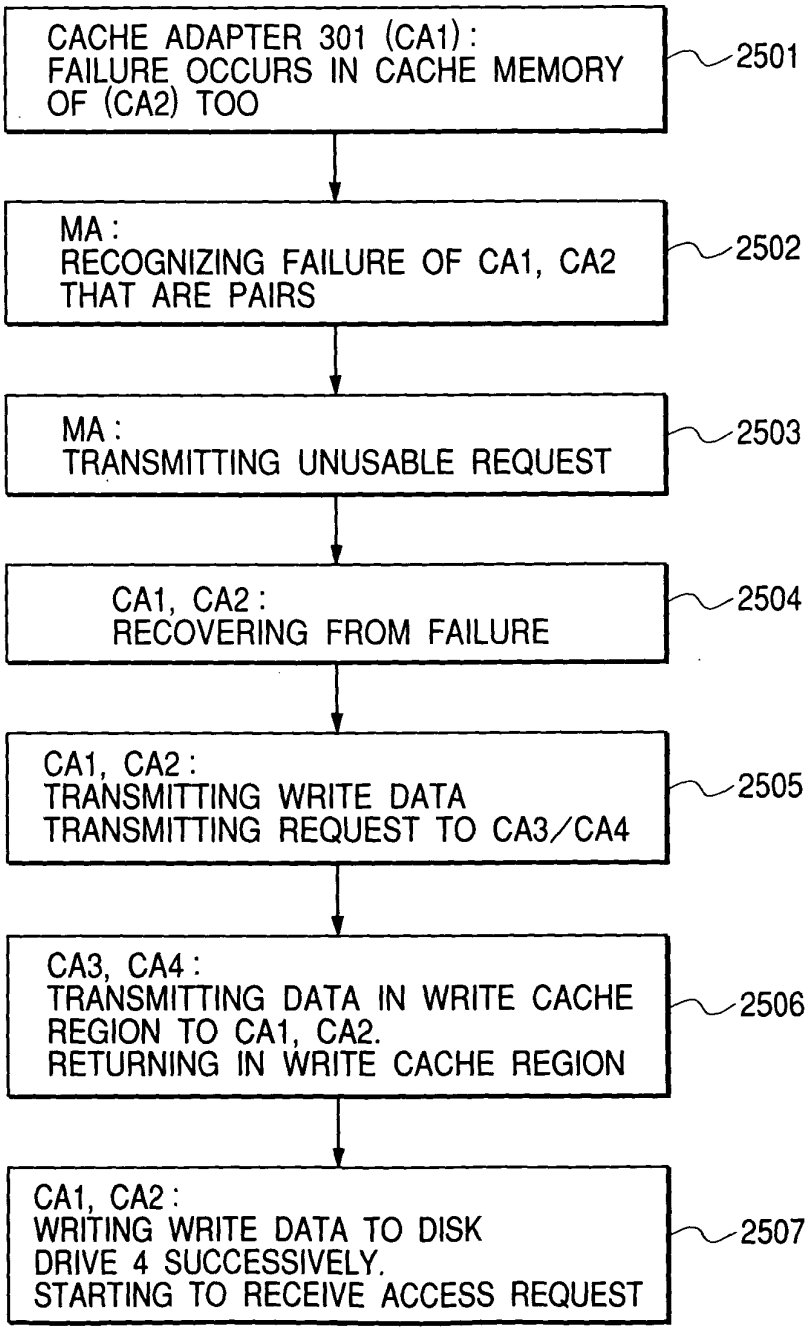
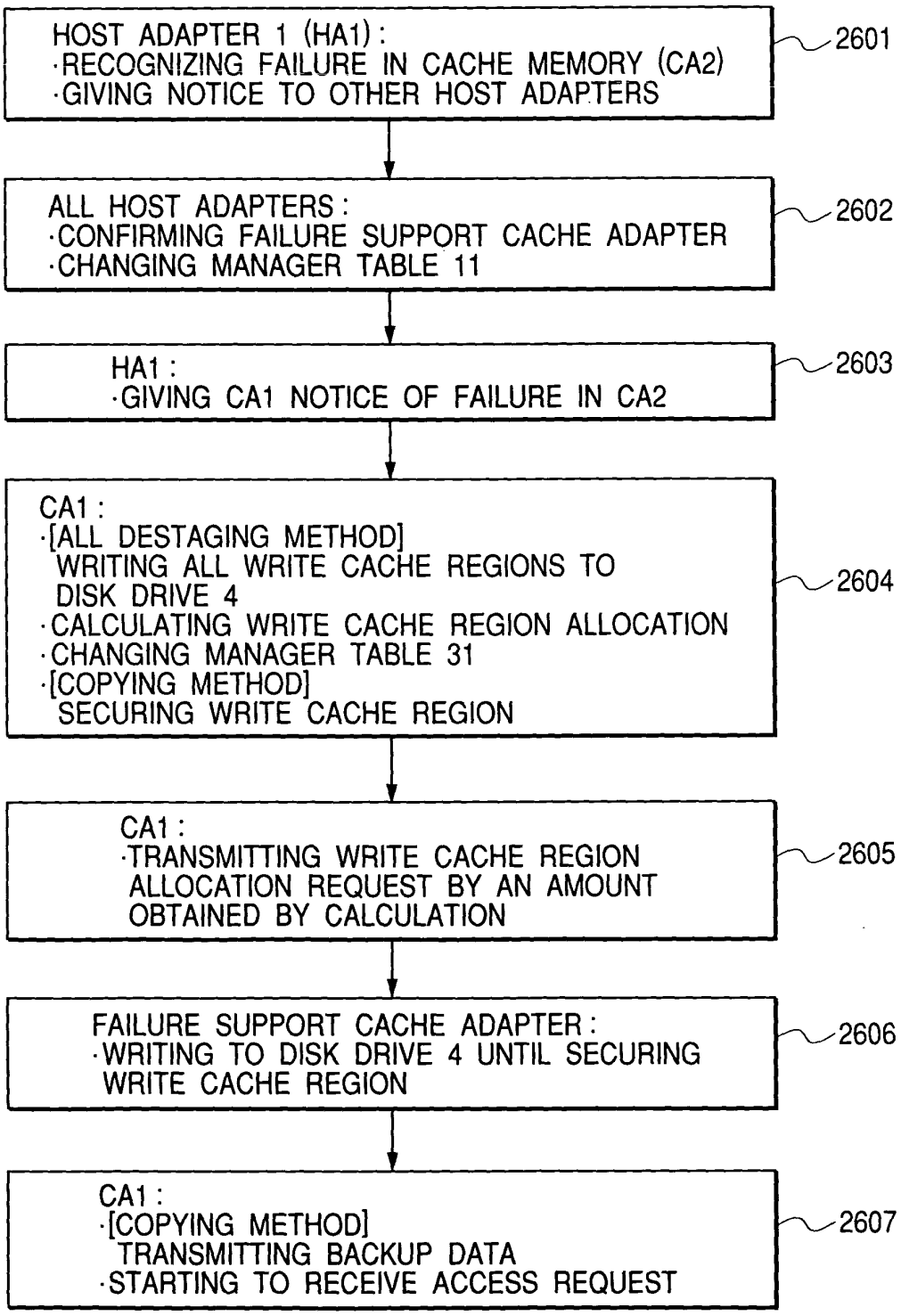

CACHE ADAPTER 301 (CA1):
FAILURE OCCURS IN CACHE MEMORY OF (CA2) TOO
2501
MA:
RECOGNIZING FAILURE OF CA1, CA2 THAT ARE PAIRS
2502
MA:
TRANSMITTING UNUSABLE REQUEST
2503
CA1, CA2:
RECOVERING FROM FAILURE
2504
CA1, CA2:
TRANSMITTING WRITE DATA
TRANSMITTING REQUEST TO CA3/CA4
2505
CA3, CA4:
TRANSMITTING DATA IN WRITE CACHE REGION TO CA1, CA2.
RETURNING IN WRITE CACHE REGION
2506
CA1, CA2:
WRITING WRITE DATA TO DISK DRIVE 4 SUCCESSIVELY.
STARTING TO RECEIVE ACCESS REQUEST
2507

FIG. 15


HOST ADAPTER 1 (HA1):
·RECOGNIZING FAILURE IN CACHE MEMORY (CA2)
·GIVING NOTICE TO OTHER HOST ADAPTERS
2601
ALL HOST ADAPTERS:
·CONFIRMING FAILURE SUPPORT CACHE ADAPTER
·CHANGING MANAGER TABLE 11
2602
HA1:
·GIVING CA1 NOTICE OF FAILURE IN CA2
2603
CA1:
·[ALL DESTAGING METHOD]
WRITING ALL WRITE CACHE REGIONS TO DISK DRIVE 4
·CALCULATING WRITE CACHE REGION ALLOCATION
·CHANGING MANAGER TABLE 31
·[COPYING METHOD]
SECURING WRITE CACHE REGION
2604
CA1:
·TRANSMITTING WRITE CACHE REGION ALLOCATION REQUEST BY AN AMOUNT OBTAINED BY CALCULATION
2605
FAILURE SUPPORT CACHE ADAPTER:
·WRITING TO DISK DRIVE 4 UNTIL SECURING WRITE CACHE REGION
2606
CA1:
·[COPYING METHOD]
TRANSMITTING BACKUP DATA
·STARTING TO RECEIVE ACCESS REQUEST
2607